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Chemical factors in canonical statistical models for relativistic heavy ion collisions

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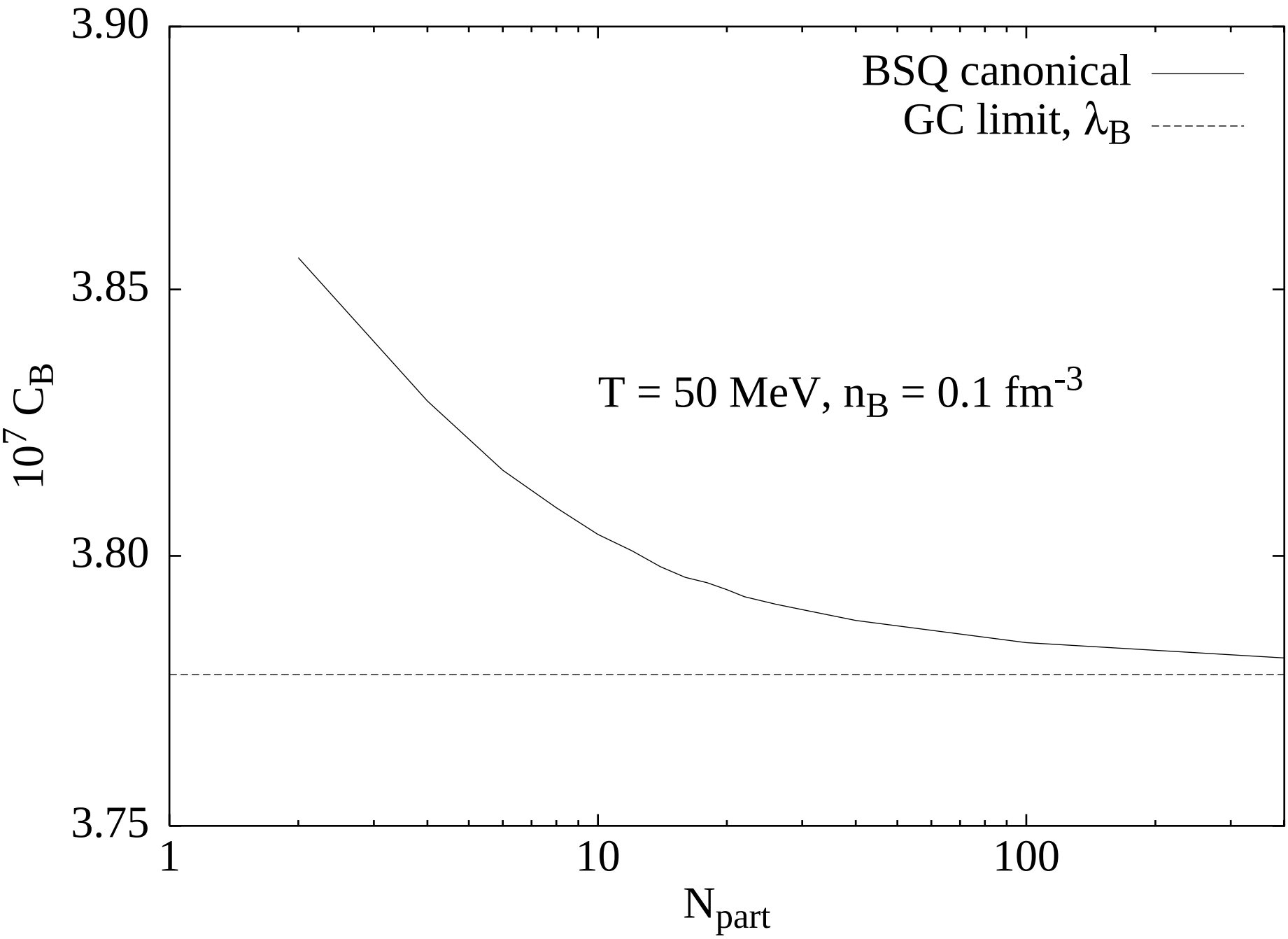
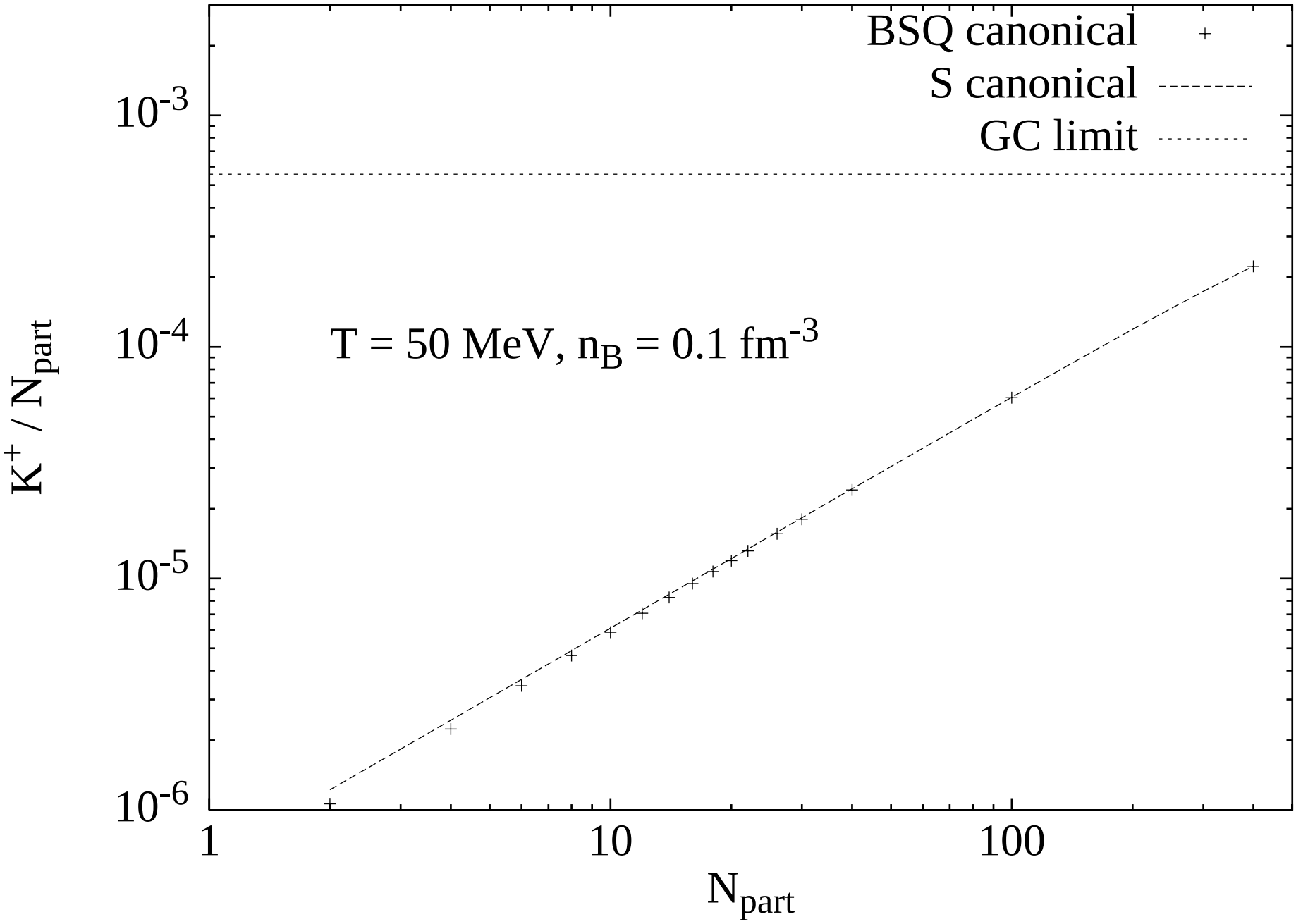
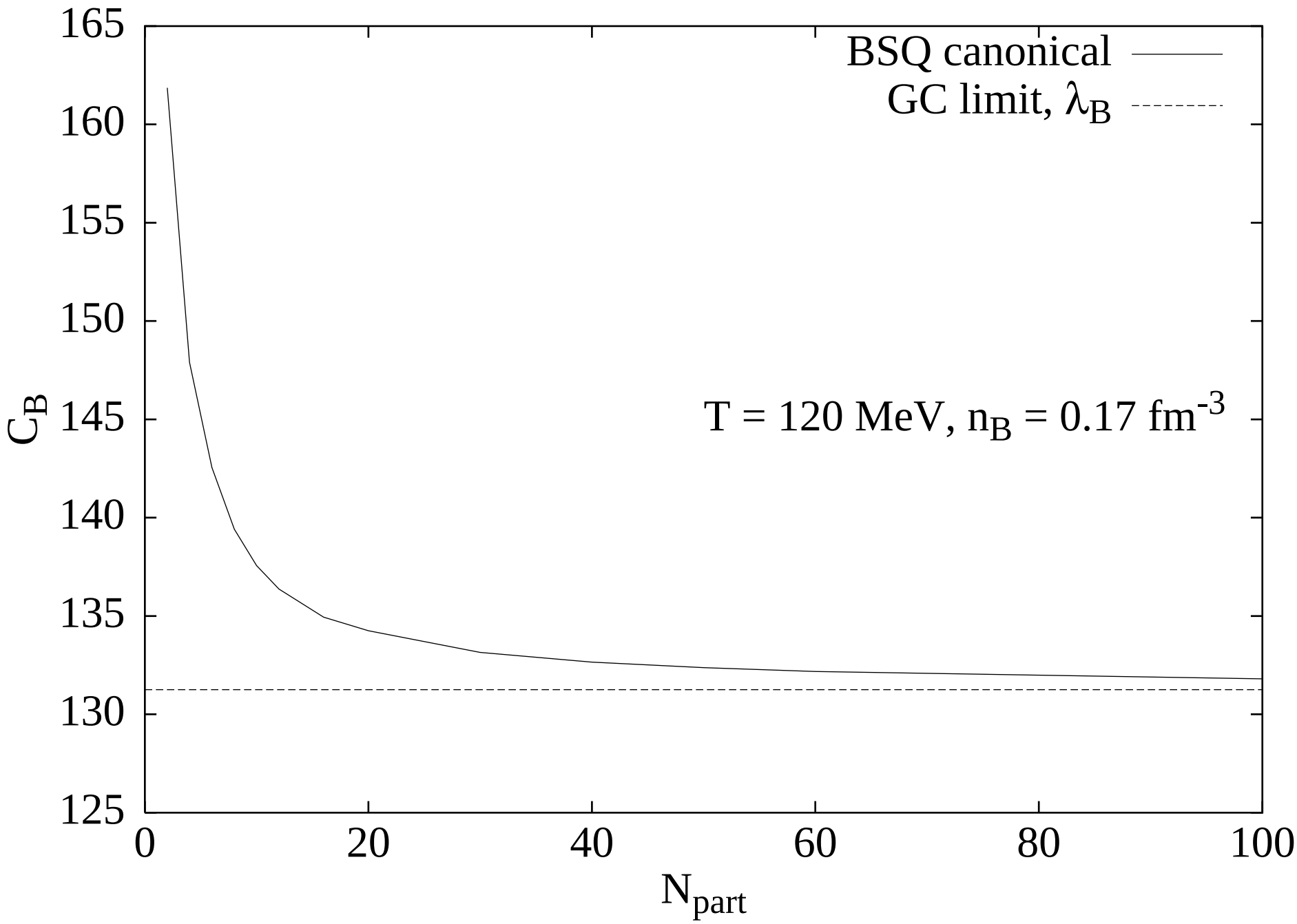
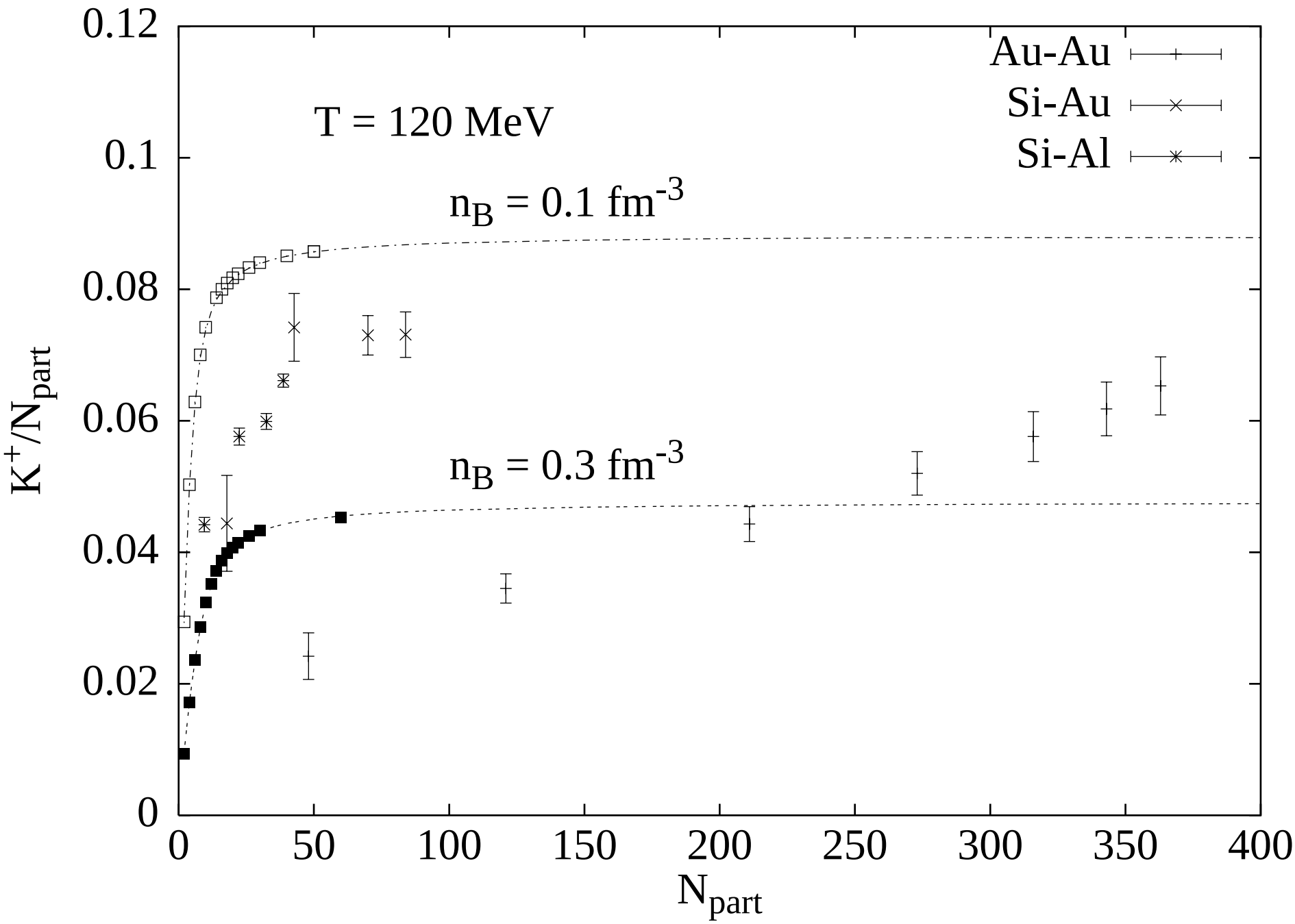
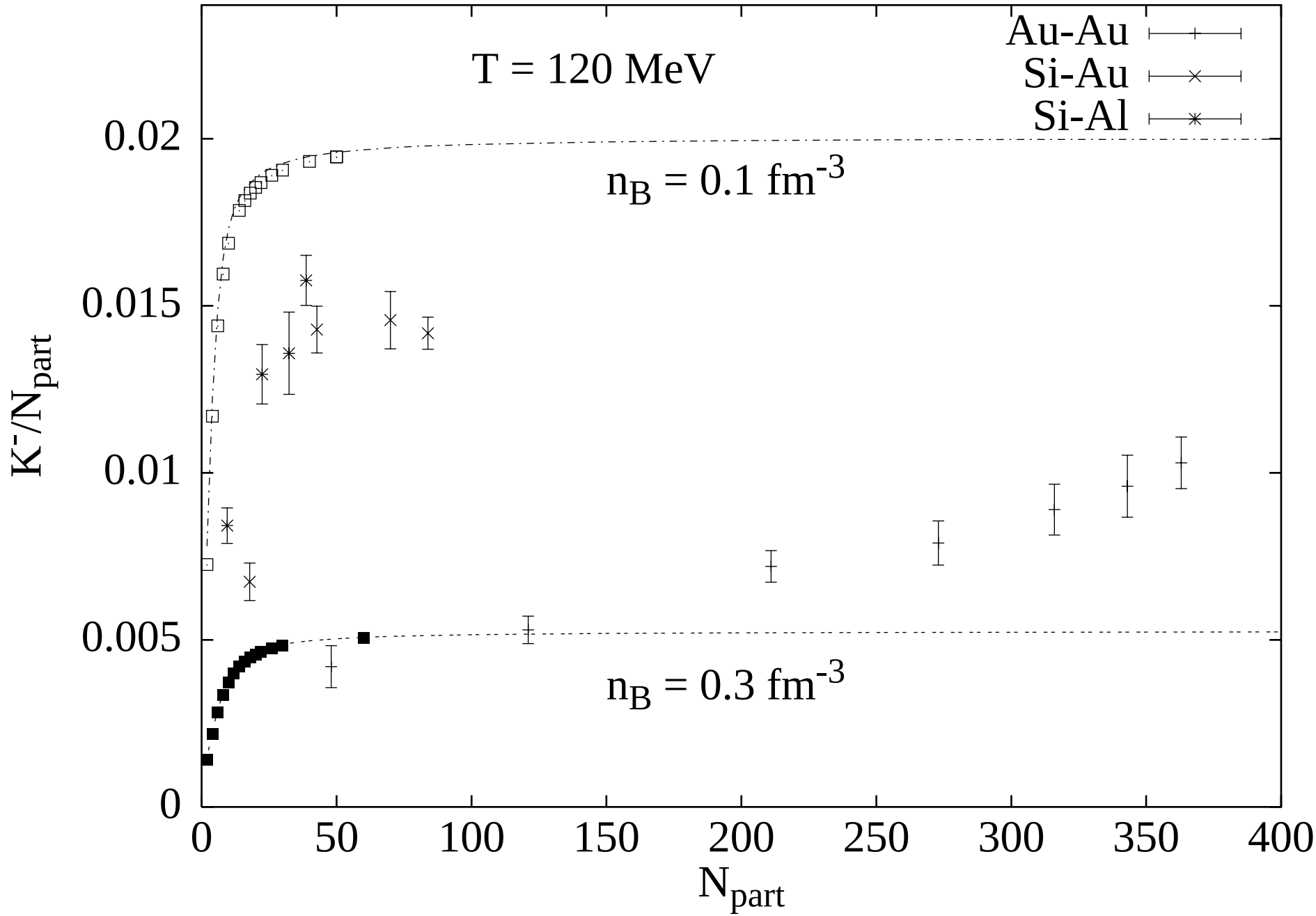
abstract We study the effect of enforcing exact conservation of charges in statistical models of particle production for systems as large as those relevant to relativistic heavy ion collisions. By using a numerical method developed for small systems, we have been able to approach the large volume limit keeping the exact canonical treatment of all relevant charges, namely baryon number, strangeness and electric charge. Hence, we hereby give the information needed in a hadron gas model whether the canonical treatment is necessary or not in actual cases. Comparison between calculations and experimental particle multiplicities is shown. Also, a discussion on relative strangeness chemical equilibrium is given.

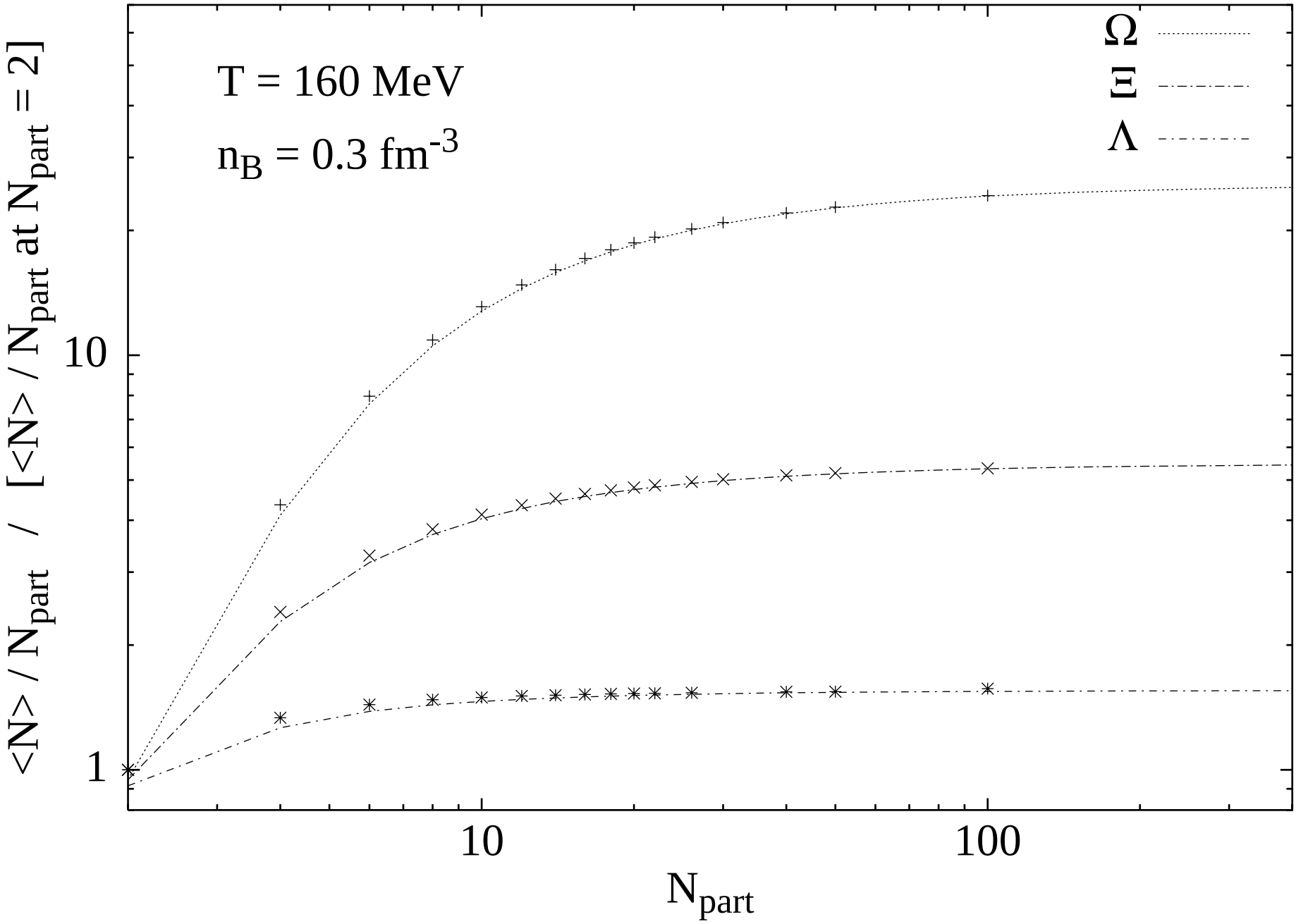

3.90
3.85
3.80
3.75
$10^7 C_B$
1
10
100
N_{part}
BSQ canonical
GC limit, λ_B
T = 50 MeV, n_B = 0.1 fm^{-3}

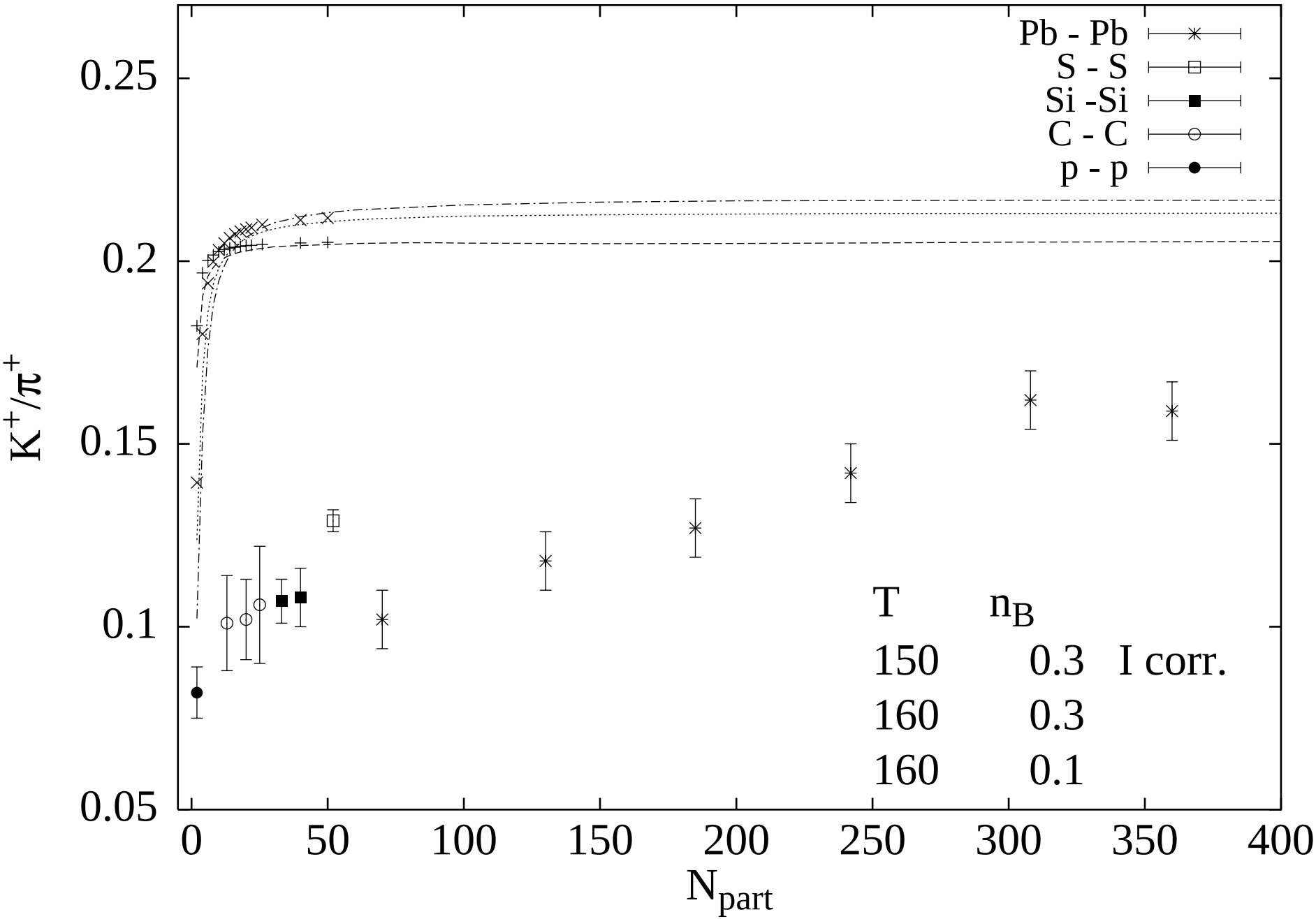

BSQ canonical
S canonical
GC limit
T = 50 MeV, n_B = 0.1 fm^{-3}
K^+ / N_{part}
N_{part}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
1
10
100


BSQ canonical
GC limit, λB
T = 120 MeV, nB = 0.17 fm-3
CB
Npart
165
160
155
150
145
140
135
130
125
0
20
40
60
80
100


0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
K^+/N_{part}
N_{part}
T = 120 MeV
n_B = 0.1 fm^{-3}
n_B = 0.3 fm^{-3}
Au-Au
Si-Au
Si-Al


T = 120 MeV
Au-Au
Si-Au
Si-Al
n_B = 0.1 fm^{-3}
n_B = 0.3 fm^{-3}
K$^-$/N$_{part}$
N$_{part}$
0
0.005
0.01
0.015
0.02
0
50
100
150
200
250
300
350
400


T = 160 MeV
n_B = 0.3 fm^{-3}
Ω
Ξ
Λ
<N> / N_{part} / [<N> / N_{part} at N_{part} = 2]
10
1
10
100
N_{part}


Pb - Pb
S - S
Si -Si
C - C
p - p
T
n_B
150 0.3 I corr.
160 0.3
160 0.1
K^+/π^+
N_{part}
0.25
0.2
0.15
0.1
0.05
0
50
100
150
200
250
300
350
400